Appendix A

Definition of Terms and Descriptions of Wastewater Systems

DEFINITIONS

Activated Sludge: A wastewater treatment process that uses suspended microorganisms to digest the organic contents of wastewater. (see "Suspended Growth Systems' in the Description of Wastewater Systems" section below)

Alternative onsite system: An onsit treatment system other than a conventional septic tank and leach field design. Alternative systems are used to accommodate a variety of site conditions (e.g., high ground water, low-permeability soil) and/or to provide additional treatment. Examples of alternative systems include alternative collection sewers, sand mounds, sand filters, anaerobic filters, disinfection systems, and cluster systems, among others, as described in "Descriptions of Wastewater Systems".

Alternative Sewers: Low-cost wastewater collection systems for small communities and/or areas with difficult topography or high ground water or bedrock. Alternative sewers are smaller in size than conventional sewers and are installed at shallower depth, providing a more cost-effective method of wastewater collection. The three main classes of alternative sewers are pressure sewers, small diameter gravity sewers, and vacuum sewers.

Black Water: Wastewater from the toilet, which contains most of the nitrogen in sewage.

BOD: Biochemical Oxygen Demand (BOD) is the measure of the amount of oxygen required by bacteria for stabilizing material that can be decomposed under aerobic conditions. BOD is a commonly used determinant of the organic strength of a waste.

Centralized System: A collection and treatment system containing collection sewers and a centralized treatment facility. Centralized systems are used to collect and treat large volumes of wastewater. The collection system typically requires large-diameter deep pipes, major excavation, and frequent manhole access. At the treatment facility, the wastewater is treated to standards required for discharge to a surface water body. The large amounts of biosolids (sludge) generated in treatment are treated and either land applied, placed on a surface disposal site, or incinerated.

Class V Well: A shallow waste disposal well, stormwater and agriculture drainage system, or other device, including a large domestic onsite wastewater system, that is used to release fluids above or into underground sources of drinking water. EPA permits these wells to inject wastes provided they meet certain requirements and do not endanger underground sources of drinking water.

Cluster System: A decentralized wastewater collection and treatment system where two or more dwellings, but less than an entire community, is served. The wastewater from several homes often is pretreated onsite by individual septic tanks before being transported through alternative sewers to an off-site nearby treatment unit that is relatively simple to operate and maintain than centralized systems.

Conventional Onsite System: A conventional onsite system includes a septic tank and a leach field.

Decentralized System: An onsite or cluster wastewater system that is used to treat and dispose of relatively small volumes of wastewater, generally from dwellings and businesses that are located relatively close together. Onsite and cluster systems are also commonly used in combination.

Effluent: Partially or fully treated wastewater flowing from a treatment unit or facility.

Eutrophication: A process by which nutrient-rich surface water or ground water contributes to stagnant, oxygen-poor surface-water environments which may be detrimental to aquatic life.

Facultative Pond: A lagoon that is sufficiently deep (i.e., 5 to 6 feet) where organic solids settle to the bottom as sludge and decay anaerobically; a liquid layer forms above the sludge where facultative and aerobic bacteria oxidize the incoming organics and products of anaerobic sludge decomposition.

Fecal Coliform Bacteria: Common, harmless forms of bacteria that are normal constituents of human intestines and found in human waste and in wastewater. Fecal coliform bacteria counts are used as an indicator of presence of pathogenic microbes.

Gray Water: Non-toilet household wastewater (e.g., from sinks, showers, etc.).

Leaching Field: See "Subsurface Soil Absorption Field".

Management of Decentralized Systems: The centralized management and monitoring of onsite or cluster wastewater systems, including, but not limited to, planning, construction, operation, maintenance, and financing programs.

National Pollutant Discharge Elimination System (NPDES): A regulatory system that requires wastewater treatment systems discharging into surface waters to obtain a permit from the EPA which specifies effluent quality.

Nonpoint Source Discharges: Relatively diffuse contamination originating from many small sources whose locations may be poorly defined. Onsite wastewater systems are one type of Nonpoint source discharge.

Onsite System: A natural system or mechanical device used to collect, treat, and discharge or reclaim wastewater from an individual dwelling without the use of community-wide sewers or a centralized treatment facility. A conventional onsite system includes a septic tank and a leach field. Other alternative types of onsite systems include at-grade systems, mound systems, sand filters and small aerobic units. These and other types of onsite systems are described in the "Description of Wastewater Systems" section.

Package Plant: Prefabricated treatment units that can serve apartment buildings, condominiums, office complexes, and up to a few hundred homes. Package plants generally are used as cluster systems, but can also be used in an onsite wastewater treatment train. They are usually of the activated sludge or trickling filter type, and require skilled maintenance programs.

Point Source Discharges: Contamination from discrete locations, such as a centralized wastewater treatment facility or a factory.

Pressure Sewers: An alternative wastewater collection system in which household wastewater is pretreated by a septic tank or grinder and pumped through small plastic sewer pipes buried at shallow depths to either a conventional gravity sewer or a treatment system. Pressure sewers are used in areas with high groundwater or bedrock, low population density, or unfavorable terrain for gravity sewer collection. They require smaller pipes and less excavation than conventional sewers. Two types of pressure sewers include:

Septic Tank Effluent Pump (STEP). A submersible pump located either in a separate chamber within a septic tank or in a pumping chamber outside the tank pumps the settled liquid through the collector main. Because the wastewater is treated in a septic tank, the treatment facility may be smaller and simpler than would otherwise be needed.

Grinder Pump. Household wastes flow by gravity directly into a prefabricated chamber located either in the basement of a house or outside the foundation wall. The chamber contains a pumping unit with grinder blades that shred the solids in the wastewater to a size that can pass through the small-diameter pressure sewers.

Pumping Stations: A pumping facility is used to lift wastewater where topography is too flat or hilly to permit natural gravity flow to treatment facility.

Receiving Water: Streams (i.e., surface water bodies) into which treated wastewater is discharged.

Residuals: The by-products of wastewater treatment processes, including sludge and septage.

Secondary Treatment: Typical effluent quality achieved by a conventional centralized treatment facility, typically defined as 85% reduction of influent BOD and TSS or 30 mg/l or both; which ever is least.

Septage: The solid and semi-solid material resulting from onsite wastewater pretreatment in a septic tank, which must be pumped, hauled, treated, and disposed of properly.

Sludge: The primarily organic solid or semi-solid product of wastewater treatment processes. The term sewage sludge is generally used to describe residuals from centralized wastewater treatment, while the term septage is used to describe the residuals from septic tanks.

Small-Diameter Gravity Sewers: An alternative wastewater collection system consisting of small-diameter collection pipes (e.g., between three and six inches) that transport liquid from a septic tank to a treatment unit, utilizing differences in elevation between upstream connections and the downstream terminus to achieve gravity flow.

Subsurface Soil Absorption Field: A subsurface land area with relatively permeable soil designed to receive pretreated wastewater from a septic tank or intermediate treatment unit (e.g., sand filter). The soil further treats the wastewater by filtration, sorption, and microbiological degradation before the water is discharged to ground water.

Trickling Filter: A fixed-film (see “Fixed Growth Systems” in “Description” section below) biological wastewater treatment process used for aerobic treatment and nitrification.

Total Suspended Solids (TSS): A measure of the amount of suspended solids found in wastewater effluent.

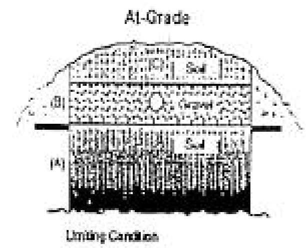
Vacuum Sewers: An alternative wastewater collection system that uses vacuum to convey household wastewater from each connection to a vacuum station which includes a collection tank and vaccum pumps. Wastewater is then pumped to a treatment facility or conventional sewer interceptor.

Appendix A (continued)

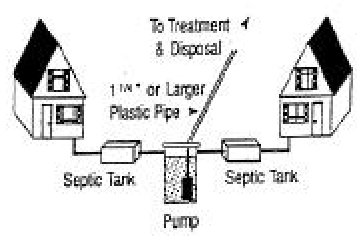
DESCRIPTIONS OF WASTEWATER SYSTEMS

Anaerobic Filters: Anaerobic filters are used as part of a treatment train designed to minimize nitrate concentration in areas where discharge of nitrates to surface water or ground water is a concern. Anaerobic filters convert nitrate (NO_3) to gaseous forms of nitrogen (N_2, N_2O, NO). The key design consideration for anaerobic filters is to ensure that the carbon-to-nitrogen ratio is sufficient for denitrification. Good performance can be obtained by treating septic tank effluent with a nitrifying (usually sand) filter before the anaerobic filter.

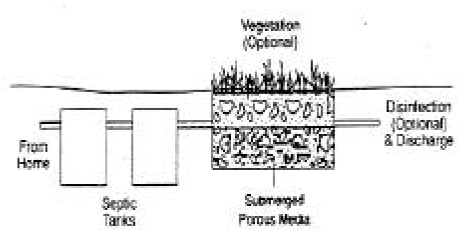
At-Grade Soil Absorption Systems: At-grade soil absorption systems are similar to the subsurface soil absorption systems, but bedding material (usually gravel) is placed at the ground surface rather than below ground and is covered with soil fill material. At-grade systems are used in areas with relatively high ground-water tables or shallow bedrock.



Cluster Systems: Decentralized wastewater collection and treatment systems serving two or more dwellings, but less than an entire community. Sometimes, the wastewater from several homes is pretreated onsite by individual septic tanks before being transported through alternative sewers to an off-site, nearby treatment unit that is relatively small compared to centralized systems.



Constructed Wetlands: Constructed wetlands are engineered systems designed to optimize the physical, chemical, and biological processes of natural wetlands for reducing BOD and TSS concentrations in wastewater. Wastewater from a septic tank flows through a pipe into the wetland, where the wastewater is evenly distributed across the wetland inlet. Sedimentation of solids with the media
substrate occurs. Constructed wetlands are reliable for BOD and TSS removal, and may contribute to nutrient removal when used after a nitrifying unit process.



Disinfection Systems: Disinfection refers to the destruction of disease-causing organisms called pathogens (e.g., bacteria, viruses) by the application of chemical or physical agents. Disinfection may be necessary where other types of treatment are inadequate to reduce pathogen levels to the required regulatory standards for surface discharge. The most common types of disinfection for decentralized systems are:

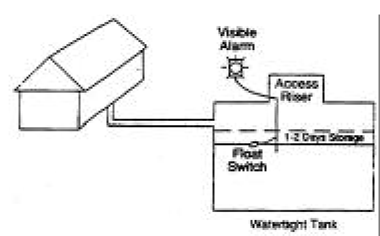
Chlorination Systems. Chlorination occurs by mixing/diffusing liquid or solid chlorine forms with wastewater. Chlorination is considered to be the most practical disinfection method for onsite wastewater treatment because it is reliable, inexpensive, and easy to use; however, dechlorination may be needed to prevent the dispersal of residuals that may be harmful to aquatic life.

Ultraviolet Disinfection. In an ultraviolet treatment system, high intensity lamps are submerged in wastewater or the lamps surround tubes that carry wastewater. Disinfection occurs when the ultraviolet light damages the genetic material of the bacterial or viral cell walls so that replication can no longer occur. Care must be taken to keep the surface of the lamps clean because surface deposits can shield the bacteria from the radiation, thus reducing the performance of the system. Ultraviolet radiation is a highly effective technique especially attractive in cluster systems where the effluent cannot include any residuals or where there are overriding concerns with safety.

Effluent Distribution Systems: Effluent distribution systems are essential components of subsurface wastewater treatment systems. These systems deliver wastewater to soil infiltrative surfaces either by gravity or by pressure distribution.

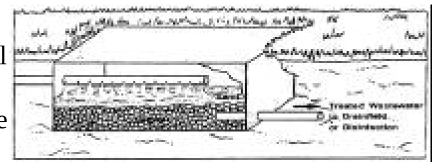
Pressure distribution. Pressure dosing systems distribute water over more infiltrative surface and provide a resting period between doses that increases the life and performance of the leach field. Dosing siphous or pumps provide the pressure; the latter requires additional maintenance demands.

Fixed Growth Systems: In fixed growth systems, aerobic microorganisms attach and grow on an inert media. Wastewater flows across a slime layer created by the attached microorganisms, which extract soluble organic matter from the wastewater as a source of carbon and energy.



Holding Tank: A large storage tank for wastewater or septage. An alarm on the tank signals when the tank is full and the contents need to be pumped and properly disposed.

Intermittent Sand Filters (ISF): An intermittent sand filter consists of sand media with a relatively uniform particle-size distribution above a gravel layer. An ISF reduces BOD and TSS concentrations to 10 mg/L or less. Wastewater passes through the filter and drains from the gravel to the collector. Uniform distribution of influent is very important to filter performance. Influent is dosed to the surface 4 to 24 times per day, with best performance from higher numbers of smaller doeses. The sand filter material may be left exposed or covered with removable covers. A septic tank (or other pretreatment system) is required to remove settleable solids and grease, which can clog the sand. Covers are used in cold climates. If sand filter material is left exposed, it must be checked regularly for litter, vegetation growing on the surface. It may require raking perodically. An uncovered system also is susceptible to potential odor problems. Less frequently, the sand may require removal and replacement of the top layer.



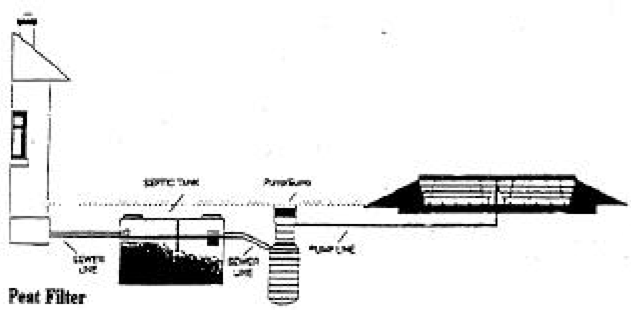
Nitrogen Removal Systems: Several types of treatment processes are capable of removing nitrogen in wastewater. Nitrogen removal systems are used in onsite treatment trains to ensure protection of ground water as well as coastal waters recharged by ground water. Biological nitrogen removal requires aerobic conditions to first nitrify the wastewater, then anaerobic conditions to denitrify nitrate-nitrogen to nitrogen gas. The successful removal of nitrogen from wastewater requires that environments conducive to nitrification and denitrification be induced and positioned properly. Three types of nitrogen removal systems are described below:

Separation of Black Water and Gray Water. Black water (toilet water) can be segregated from other sources of household wastewater (gray water) for separate treatment and disposal. A separate plumbing system within a house is required. Black water, which contains 80% or more of the nitrogen in household wastewater, can be discharged directly to a holding tank; the remaining gray water is discharged to a septic tank/soil absorption system.

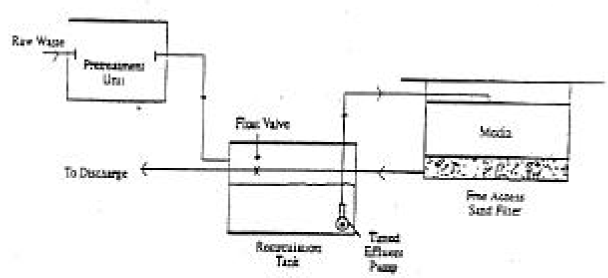
Nitrification/Denitrification Trickling Filter Plant. Septic tank effluent is recycled by a pump toa low-loaded, plastic-media trickling filter for aerobic treatment; and nitrification can occur. Filtrate from the trickling filter returns to the lower anaerobic septic tank effluent, providing an environment conducive to biological denitrification.

Recirculating Sand Filters. Recirculating sand filters also can provide consistent nitrogen removal (See “Recirculating Sand Filter” below).

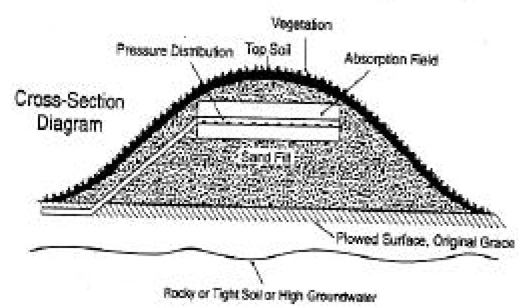
Non-Sand Filters: Non-sand filters function similarly to sand filters but use materials other than sand as the filter medium, including natural media such as peat and bottom ash, and synthetic media such as expanded polyurethane foam and honeycombed plastic to reduce levels of TSS, BOD, and fecal coliforms. Most non-sand filter media are packaged in units or placed in enclosures and use pressure dosing to distribute the effluent in the filter.



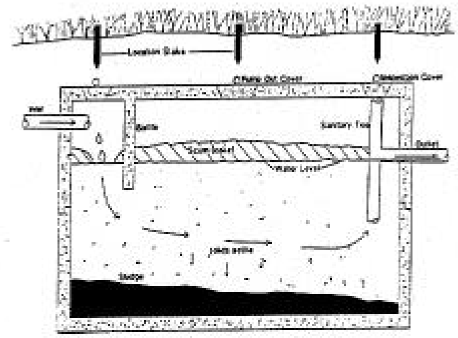
Recirculating Sand Filters (RSF): A recirculating sand filter uses relatively coarse sand or gravel media for filtration of wastewater. The wastewater is dosed from a recirculating tank, which receives septic tank effluent and returned filtrate. A portion of the filtrate is diverted for disposal during each dose. RSFs are suitable in areas too small for conventional soil absorption systems or with shallow depths to groundwater or bedrock. RSFs can be used for reducing TSS, BOD, fecal coliform, and nitrogen. RSFs are reliable, requiring little maintenance in comparison to activated sludge systems.



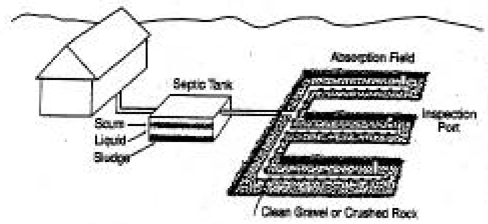
Sand Mounds: Sand mounds are used when soil depth is too shallow for a conventional septic tank and leach field system. The sand mound filters septic tank effluent before it reaches the natural soil. Sand fill is placed above the ground surface, and a pipe distribution system and pressure dosing is used to distribute the effluent. A septic tank or other pretreatment is required to remove settleable solids and grease.



Septic Tank: A buried tank designed and constructed to receive and pretreat wastewater from individual homes by separating settleable and floatable solids from the wsteater. Grease and other light materials, collectively called scum, float to the top. Gases are normally vented through the building's sewer pipe. An outlet blocked off from the scum layer feeds effluent to a subsurface soil absorption area or an intermediate treatment unit.

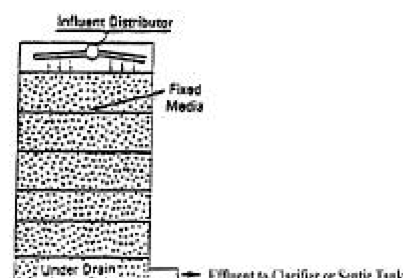


Subsurface Soil Absorption Systems: A typical soil absorption system consists of perforated piping and gravel in a field or trench, although gravelless systems can also be used. Soil absorption systems are normally placed at relatively shallow depths (e.g., <2 ft). Excellent TSS, BOD, phosphorus, and pathogen removal is provided in the unsaturated soil which surrounds the infiltrative surfaces. If properly sited, designed, constructed, and maintained, subsurface soil absorption systems are very reliable and can be expected to function for many years.



Suspended Growth Systems: Suspended growth treatment systems are variations of the activated sludge process in which microorganisms are suspended in an aerated reactor by mixing. Oxygen is supplied to oxidize organic carbon and, possibly, nitrogen compounds. Effluent is discharged either to surface water or subsurface systems . Suspended growth systems can be engineered as package plants to serve clustered residential housing, commercial establishments, or small communities with relatively small flows.

Trickling Filters: Used to reduce BOD, pathogens, and nitrogen levels, trickling filters are composed of a bed of porous material (rocks, slag, plastic media, or any other medium with a high surface area and high on permeability). Wastewater is first distributed over the surface of the media where it flows downward as a thin film over the media surface for aerobic treatment and is then collected at the bottom through an underdrain system. The effluent is then settled by gravity to remove biological solids prior to being discharged.



Appendix B

The Wastewater Planning Process

Appendix B The Wastewater Planning Process

The wastewater planning process involves coordinating a variety of technical and institutional factors, including engineering environment legislative, public education socioeconomic and administrative considerations, as shown in Figure B.1. The goal of the wastewater planning process is to develop a comprehensive plan to guide the community in the selection, siting construction, operation, maintenance, and financing of wastewater systems that address the wastewater needs of the community. A key part of the planning process is a systematic evaluation of the financial and regulatory feasibility of all practical centralized and decentralized engineering alternatives. The steps in a wastewater planning process typically include (Arenovski and Shephard 1996):

Needs assessment-establishing an overall commmunity profile, including current and future needs and issues and identifying areas of concern where existing wastewater facilitiess are inadequate or problems might occur in the future.

- Development and screening of altematives - examining which technology, or combination of technologies, will best address the concerns the community faces. The alternatives to consider include expanding or upgrading existing systems or improving their operation and maintenance, as well as installing new systems.

- Evaluation of community-wide plans-comparing the feasibility and cost-effectiveness of a small number of viable plans, and comparing each to a "baseline alternative" of maximizing the use of misting facilities.

In many communities, results of wastewater planning efforts will indicate that the best option is choosing several alternatives-that is, decentralized onsite wastewater systems in one part of the community, decentralized cluster systems in other sections, and a centralized facility in another part of town. This type of integrated approach reinforces land use planning it also emphasizes the need for adequate management of decentralized systems, and for centralized and decentralized systems to be managed together by a central oversight agency (Shephard 1996).

Comprehensive Planning

Wastewater system options are best selected in conjunction with broader, comprehensive community planning efforts to ensure that overall community goals are being met, such as enviromental protection and land use goals. The planning process includes an analysis of the physical, social, economic cultural, and environmental characteristics of the planning area. For example, if a watershed protection program already exists in a region to protect sensitive 'environmental areas, more advanced wastewater treatment (e.g., disinfection or nutrient removal) might be included as part of the watershed program, whether as part of a cenralized or decentralized wastewater system (note that a decentralized system would allow the flexibility of installing advanced treatment only for those dwellings in close proximity to the sensitive areas). Similarly, if local land-use planning efforts include maintaining open space and Conservation/woodland areas, wastewater management choices can complement such efforts (e.g., by encouraging cluster developments serviced by cluster wastewater systems).

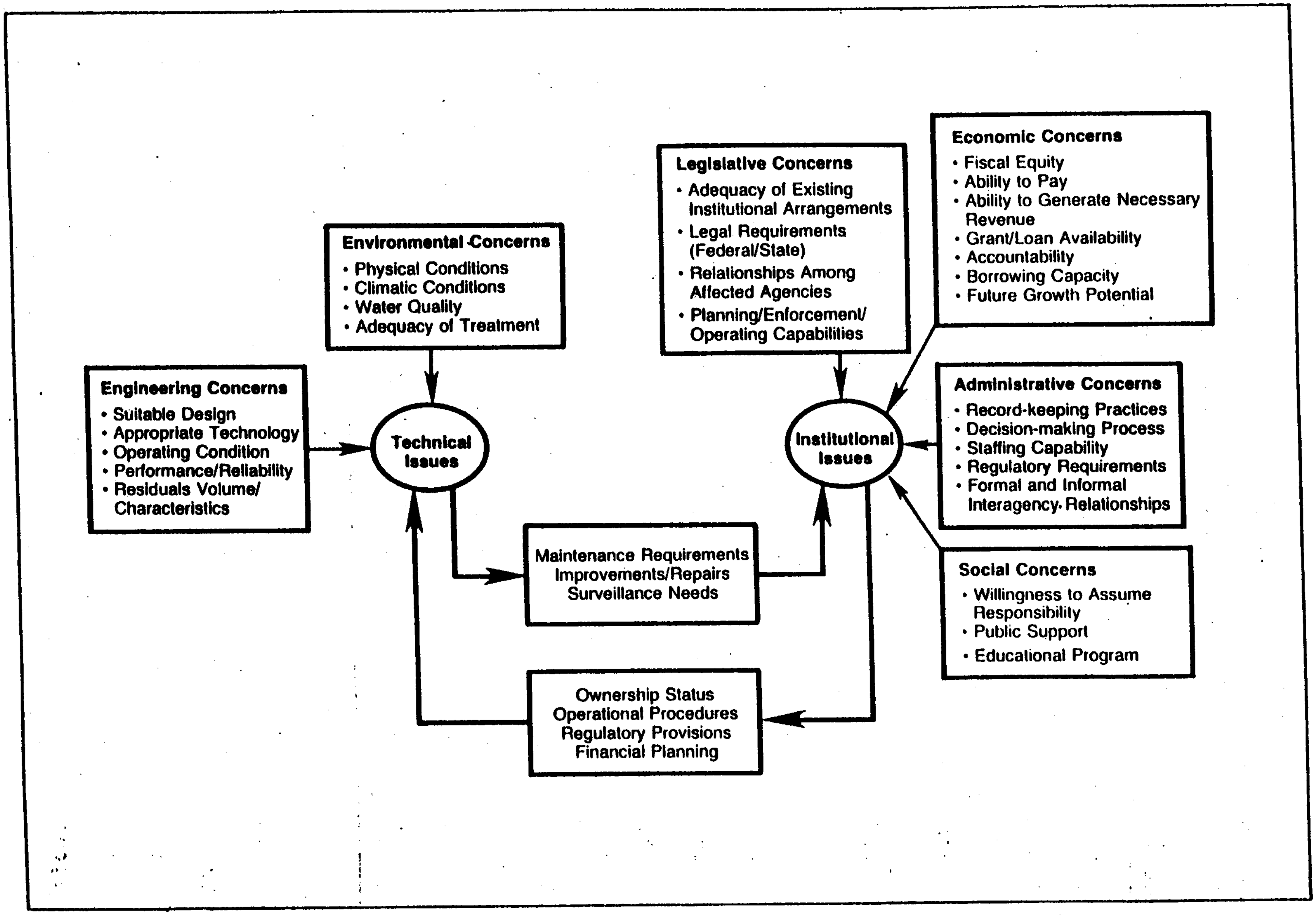


Figure B-1. Technical and institutional factors in decentralized wastewater systems management planning.

Appendix C

Types of Management Structures for Decentralized Wastewater Systems

Appendix C: Types of Management Structures for Decentralized Wastewater Systems

Table C-1.   Management Structures

Management Entity	State Agency	County	Municipality	Special District	Improvement District	Public Authority	Public Nonprofit Corp.	Private Nonprofit Corp.	Private For Profit Corp.
Description	Environmental protection agencies, health departments, and public utilities	Most basic political subdivision in a state. Comprised of incorp. munic. and unincorp. areas.	Cities, towns, villages, and townships.	Performs functions prescribed by state-enabling legislation. Provides single or multiple services.	Device used by counties/ munic. to provide services to local gov. jurisdictions.	Authorized to administer a revenue-producing public enterprise. Similar to a special district.	Provides water or wastewater services on behalf of local governments.	Established by the users of a facility to assist in facility financing and operation.	Can design, operate, or maintain sewerage facilities.
Service Area	Program enforcement can be handled on a regional basis.	Provides service throughout its juris. and to defined areas via improvement districts.	Provides service throughout its juris. and to defined areas via improvement districts.	Flexible	One or more as part of a single jurisdiction.	Flexible	Flexible (single community, group of communities, or statewide)	Can include subdivisions, small communities, and rural areas	Flexible (single homeowner to small community)
Governing Body	State legislature. Agencies report to the governor, legislature, or to a board of directors	Includes elected (princ. legislative branch) county board commission, council-administrator, council-elected executive.	Mayor-council, commission, and council-manager.	Board of directors (elected, appointed, or existing agency members)	Governing body of the creating unit of government.	Board of directors (elected or members of local government)	Usually municipal or state officials.	Board of directors elected by stockholders or a property owners association.	Private utility has stockholders or investors. Public utility commission (PUC) has jurisdiction.
Responsibilities	Code enforcement of wastewater design, installation, and operation standards; and technical and financial assistance.	Coordinates munic. in its juris.; provides special services on contract basis; serves as a fiscal agent for other local units of government.	Provides a wide range of services.	All wastewater management functions, similar to local government. State defines function and scope.	State statutes define extent of authority. Usually applied to finance public service improvements.	Used primarily for financing capabilities.	Serves as financing mechanism. Can provide technical assistance to small communities.	Provides financing and operational functions.	Active and flexible role to play in managing small wastewater systems.

Management Entity	State Agency	County	Municipality	Special District	Improvement District	Public Authority	Public Nonprofit Corp.	Private Nonprofit Corp.	Private For Profit Corp.
Financing Capabilities	Provides financial support through federal grants and state revenues.	Charges for sewerage sources and finance construction through taxation, general funds, special assess-ments, bonds, and permit fees.	Has a broad range of fiscal powers (similar to counties).	Local taxation, service charges, special assess-ments, grants, loans, bonds, and permit fees.	Can apply special property assessments, user charges, other fees. Can sell bonds.	Can use revenue bonds, user charges, and connection fees.	User charges and services fees and sales of stocks and tax-exempt bonds. Can accept some Federal grants and loans.	Eligible for Federal grants and loans.	User charges. The PUC can influence the service rates charged.
Advantages	Regulatory and financial advantages over local government. State enforce-ment can insulate from local political pressure. Can administer training/cert. programs.	Can interact with states and local governments on many issues. Often seen as administrative arms of the state. Provide efficient resource base for providing public services.	Can better react to local perception and attitude.	Flexible. Renders equitable services (only those receiving services pay for them). Simple, independent forms of government.	Can extend public services without major expenditures. People in the benefitted area usually favor the improvement.	Good when local governments are not able to provide public service because of financial, administrative, or political problems. Has a certain degree of autonomy.	Offers flexibility in establishing management facilities and financing facilities by state and local governments. Financing method doe not affect local debt limitations.	Provides public services where local govern-ments are unwilling or unable.	Frees the local public sector from providing these services. Competition between firms will help maintain quality while keeping costs down.
Disadvantages	Program organizations differ. (Difficult to implement methods from one state in another. Can become distanced from local governments.	Sometimes not willing to provide specialized public services to a defined service area. Community debt limits could be restrictive.	Might lack admin. capa-bilities, staff, or willingness to design, install, operate, and/or regulate a facility. Financial capabilities might be limited.	Can promote proliferation of local govern-ment and duplication and fragmentation of public services. Fiscal problem could result from overuse.	Contributes to fragmentation of local government services. Can result in administrative delays.	Financing ability is limited to revenue bonds. Thus, local government must support the debt incurred by the public authority.	Local governments might be reluctant to apply this concept.	Services could be of poor quality or could be terminated.	Threat that the company could go out of business. Private corporations are usually not qualified for federal and state grant and loan programs.

Source: Ciotoli and Wiswall, 1982.

In addition to the types of management structures described above, two additional approaches to managing decentralized wastewater systems include public/private partnerships and management districts, as describe below.

Public/Private Partnerships. It is sometimes difficult to determine which parties are responsible for the various decentralized system management functions because of the split responsibility between the public and private sector. Several options exist for public/private partnerships in the management of decentralized systems. Systems can be privately owned and managed under a permit system, privately owned and publicly managed, or publicly owned and managed. In the first option, the resident must comply with the regulations and pays all costs for maintenance, pumping, and if necessary, rehabilitation. In the second option, the resident pays user charges to the local district which performs the necessary maintenance (this does not cover rehabilitation). The final option involves the public organization providing wastewater services for all households and collecting user charges to pay for the service; all construction, operation, and maintenance tasks are performed by the public agency, or firms under contract to it.

Wastewater Management District. When a government agency or public authority is unable or unwilling to assume the life-cycle management of decentralized wastewater systems, a special management entity, such as a management district, can be formed where state statutes permit. This management option involves incorporating decentralized systems into a local or regional wastewater management district, with district personnel responsible for system operation and maintenance. Decentralized wastewater management districts have been in existence since 1972, when Georgetown, California implemented a community-wide onsite wastewater system management program in the Lake Auburn Trails subdivision (Shephard, 1996).

The following table summarizes a number of decentralized wastewater management programs that have been implemented as management districts throughout the country. For a further discussion of management systems for decentralized wastewater treatment systems, see Shephard (1996).

Table C-2. Management Districts: Summary of Case Study Characteristics

Case Study	Funding Source	Size of Area	Waterbody Protected	Program Components
Crystal Lakes, CO	Annual dues ($60 per lot, $100 per lot if served by central water and sewer, $180 per lot if connected to seasonal central water and sewer)	4,000 lots	Crystal Lakes	Developer establishes and manages decentralized water and wastewater facilities in the subdivision. Management is funded through annual dues and includes, maintenance, removal of sewage from vaults, and delivery of drinking water to cisterns.
Crystal Lake, MI	Not Reported	1,100 homes	Crystal Lake	Establishment of new ordinances: (1) inspection/upgrade required prior to sale, (2) homeowners required to report on all systems, (3) health department required to inspect the systems, (4) systems must be upgraded within 120 days of inspection if failed, and (5) non-compliance meets with tough consequences.
Georgetown Divide, CA	Annual dues ($12.75 to $22.75), design costs ($540 per system), and hook-up fees ($875 per system)	3,000 acres	American River	Management entity is responsible for operations and maintenance, repair and inspection, system design, control of installation and siting, and control of building process. Inspection and maintenance program is database-controlled.
Kueka Lake, NY	$300 per year per parcel fee	Not Reported	Kueka Lake	Management entity responsible for evaluating, monitoring, and setting standards. Ordinances established include (1) the town had ultimate authority, (2) a mix of system designs was allowed, (3) annual inspection were required for highly technical systems, (4) systems within 200 feet of the lake must be inspected every 5 years, (6) systems must be inspected prior to property transfer, and (7) enforcement powers.
Stinson Beach, CA	Funds obtained from tax revenues, semiannual fee of $53, and charges for special inspections and inspection for compliance.	700 onsite systems	Groundwater/ Coastal waters	The District's management activities include inspection of system installation and routine system operation, and water quality monitoring. The district's rules and regulations specify the criteria to be used when issuing permits for new onsite systems, as well as for the repair and/or replacement of existing systems. Most of the systems in the community are inspected at least once a year; the systems that have been corrected or replaced, however, are inspected two or three times a year. District has a broad range of regulatory authority to perform onsite management functions.

Table C-2 (continued)

Case Study	Funding Source	Size of Area	Waterbody Protected	Program Components
Guysborough, Nova Scotia	Initial Funds: $2,500 fee per equiv. unit or property, funds from Capital Assist.e Program (50% of total), and funds from the Council of the Municipality of Guysborough (26% of total) Funds for Management Program: Connection fee of $3,500. Annual property tax equal to the expected annual maintenance fee plus an amount to be set aside for future capital.	700 residents	Guysborough harbor	Built a Rotating Biological Contactor type sewage treatment facility to service the main core of the community. Second, a portion of the District was connected by sewer lines to an aerated lagoon system. The remaining properties within the District have been serviced by individual on-site systems. The municipality hired one employee to be responsible for the general maintenance of the treatment plant and lagoon systems. A preventative maintenance was established for the onsite systems
Cass County, MN	$3,800 per resident initial cost; annual fee of $12 to $15	110 miles, 85 towns	numerous lakes, streams	In 1994, the county developed an "Environmental Subordinate Service District," whereby a township, as the local unit of government, can effectively provide, finance, and administrate government services for subsets of its residents. Establishment of such districts within a town is authorized under MN Statute 365A. The purpose of these districts is to provide a self-sufficient, effective, and consistent long-term management tool, chiefly for neighborhood alternative (STEP) collection and communal leach fields. This innovative model stays at the grass roots level where the affected property owners and township are involved. Cass County provides technical and support assistance when required, but is not directly involved. The partnering with the townships and the county has allowed resource sharing, improved communication, and thus has opened up prospects for other cooperative ventures such as land-use planning, road improvements, and GIS use. Once a Subordinate Service District is created by petition and vote from the residents needing the specific service, a County/Township agreement is signed. The County then determines the system's design, handles construction oversight, gives final approval for the collection system, commits to yearly inspections, and assures regulatory compliance. The leach fields are located away from lakes, wells, and groundwater supplies. Cass County will allow systems to lie on county-administered land in order to defray residents' costs, or to enable optimal siting (Shephard, 1995).

Appendix D

Cost Estimation Methodology

COST ESTIMATION METHODOLOGY

The cost estimation methodologies for conventional gravity and alternative collection systems, as well as centralized treatment, cluster treatment, and onsite treatment systems, are presented in this appendix. The cost estimates include the capital cost necessary to install the system(s) and the annual cost to repair and maintain the system(s). Capital costs are annualized over 30 years (the life of the system) using a discount rate of 7 percent (OMB, 1996). All costs are presented in 1995 dollars. Cost data for the different technologies have been obtained from various sources, as documented in each section. Because the data reflect costs from different years, they have been indexed to 1995 dollars using the Means Historical Cost Indexes, as printed in the “Engineering News-Record (ENR)”(Means Heavy Construction Cost Data, 1996). Costs are indexed using the following equation:

$$1995\ \mathit{Cost} \qquad 1987\ \mathit{Cost}\ x\ \frac{1995\ \mathit{Index}}{1987\ \mathit{Index}}$$

Indexes applicable to the costs presented in this appendix are:

Table D-1. Cost Indexes

Year	Index
1976	46.9
1978	53.5
1987	87.7
1991	96.8
1992	99.4
1995	107.6

COLLECTION SYSTEMS

Conventional Gravity Collection

A conventional gravity collection sewer collects and transports sewage to a centralized treatment facility via gravity. The system includes lateral pipes, collection sewers, interceptor sewers, manholes, and pump stations. Laterals are the pipes that transport wastewater from homes to the collection main sewers. Collection sewers are the pipes which carry the wastewater to interceptor sewers, which carry wastewater to the treatment system with the help of pump stations if needed. Manholes are included along the collection sewer to allow access for cleaning.

Because the pipes in a gravity collection system must continually slope downward, pump stations may be required to avoid excessive excavation for pipes or to reach a particular elevation at the system outfall. Pump stations (or lift stations) include pumps, valves, and a well to hold incoming sewage.

Cost Data

Cost estimates were developed for a conventional gravity collection system using cost equations developed by Dames and Moore. These equations were derived from actual installation and annual operating and maintenance (O&M) costs (Smith, 1978). The cost estimating procedure calculates costs in 1978 dollars because these were the best data available; the costs were then indexed to 1995 dollars.

Pipe Diameter - Dames and Moore provide an equation for estimating the capital costs of the lateral, collection main, and interceptor sewer pipes on a dollar per foot basis. This equation relates the cost of the pipe to the diameter of pipe required:

$$\frac{\$}{foot}\ (1978\ dollars) \quad 3.2\ x\ (pipe\ \ diameter)^{1.1667}\ x\ 1.03$$

Dames and Moore also provide an equation to determine the diameter of pipe required for the collection and interceptor sewer, based on the flow of wastewater through the pipe:

$$Pipe\ \ diameter \quad 17.74\ x\ Flow\ \ (mgd)^{0.3756}$$

A minimum pipe diameter of 8 inches was used for the collection and interceptor sewers (Fact Sheet, n.d.), unless a larger pipe size was required for the design flow. A pipe diameter of 4 inches was used for on-lot lateral pipes.

Pipe Length - The length of collection sewer required is dependent on the population density. Dames and Moore provide an equation for estimating this length:

$$\frac{feet\ \ of\ \ sewer}{capita} \quad 54\ x\ (\frac{persons}{acre})^{0.65}$$

The length of interceptor pipe needed to transport the wastewater to a newly constructed treatment facility in the rural community is estimated to be about one mile. The length of interceptor pipe for the fringe community needed to transport wastewater to an existing facility in the metropolitan center was estimated between one and five miles. On-lot lateral pipes are estimated to be about 50 feet per home in the rural community, and 25 feet per home in the fringe community.

Lift/Pump Stations - The number of pump stations required in a system is dependent on the site topography. Dames and Moore estimate the number of pump stations to be one for every 18,000 feet of collection and interceptor length; however, additional pump stations are necessary if the topography is hilly or steep. The cost to install pump stations is dependent on the flow of wastewater and is estimated by the following equation:

$$\textit{Cost per station}\ (1978\ \$)\quad 0.168\ x\ (\textit{flow, mgd})^{1.08}\ x\ 1.03$$

A minimum cost of $50,000 (1995$) was used for construction of pump stations.

Annual costs to repair and maintain gravity collection sewers were also estimated from Dames and Moore data; average operating and maintenance costs for sewers is $1,502 per mile of sewer line (1978 dollars).

System Design and Cost

The following conventional gravity collection systems were designed and costed for the fringe and rural communities using the methodology presented above:

1) Installation of a conventional gravity sewer in the fringe community, with an additional 1-5 miles of pipe to connect this system to the existing sewer system in the metropolitan center.

2) Installation of a conventional gravity sewer in the rural community to be connected to a new rural community treatment plant located within one mile of the community.

Fringe Community Costs (1995 $)

The collection system for the fringe community is estimated to require about 25,000 feet of 10-inch diameter collection pipe, between 5,280 and 26,400 feet of 10-inch interceptor pipe, 11,000 feet of 4-inch lateral pipe, and three pump stations. The capital cost to install this system ranges from $3,322,900 to $5,377,800, depending on the distance of interceptor pipe required. The annual O&M costs are estimated to range between $23,000 and $35,000.

Rural Community Costs (1995 $)

Population density has a significant impact on the cost of collection, and ultimately makes up a large percentage of the cost to connect an area to centralized treatment. For this reason the cost of collection for the rural community was calculated using two population densities: a moderate density of 1 home per 1.5 acres and a low density of 1 home per 5 acres.

The collection system for the rural area when the population density is moderate is estimated to require about 15,500 feet of 8-inch diameter collection pipe, 5,280 feet of 8-inch diameter interceptor pipe, 6,800 feet of 4-inch diameter lateral pipe, and two pump stations. The capital cost to install this system is estimated to be $1,882,800 and the annual O&M costs are estimated to be about $15,750.

The collection system for the rural area when the population density is moderate is estimated to require about 15,500 feet of 8-inch diameter collection pipe, 5,280 feet of 8-inch diameter interceptor pipe, 6,800 feet of 4-inch diameter lateral pipe, and two pump stations. The capital cost to install this system is estimated to be $1,882,800 and the annual O&M costs are estimated to be about $15,750.

The collection system for the rural area when the population density is low is estimated to require about 34,000 feet of 8-inch diameter collection pipe, 5,280 feet of 8-inch diameter interceptor pipe, 6,800 feet of 4-inch lateral pipe, and three pump stations. The capital cost to install this system is estimated at $3,311,500 and the estimated annual O&M costs are about $26,300.

Alternative SDGS Collection

Alternative collection sewers are used in place of, or in conjunction with, conventional gravity collection sewers to collect and transport wastewater to a central treatment facility. Small diameter gravity sewers (SDGS) area system of interceptor pipes and tanks and small diameter PVC collection mains. Onsite tanks are used to remove grease and settleable solids, allowing for the smaller diameter collection pipe to be used. The settled wastewater is discharged from the septic tank via gravity into the collector mains (EPA, 1991) . The collector mains then transport the wastewater to a local cluster system, a centralized treatment facility, or a conventional collection system. The main components of an SDGS are 3-inch to 8-inch PVC mains, cleanouts or manholes, vents, and septic tanks.

cost Data

Several sources were reviewed to obtain cost data on SDGS systems. These sources include :

- EPA Manual on Alternative Collection (EPA, 1991)
- Fountain Run Case Study (Abney, 1976)
- Region IV Survey (EPA, n.d.)

The EPA alternative collection manual provides unit cost data (mid-1991) for interceptor tanks and 4-inch mains. The manual also contains design data and SDGS systems for several small communities; these communities were located in areas with steep and hilly topography. These systems were also designed to feed into central treatment facilities, instead of local cluster treatment systems. These differences are the reason why the sewer designs for these communities were not applied to the hypothetical communities.

The Fountain Run case study provides design information for a community divided into clusters ranging from 3 homes to 34 homes. The study did not indicate any prevailing topographic conditions which would hinder the construction of a SDGS. The study also provided unit cost data (1976) for the SDGS components, but these were not used since more recent unit cost information is available from the EPA alternative collection manual.

The Region IV survey contains design and project cost information on alternative collection systems. The SDGS projects were all designed to feed into centralized treatment facilities, therefore, these projects are not applied to the hypothetical communities.

System Design and Cost

The SDGS system was chosen to collect and transport wastewater to a local cluster treatment system. The homes in the hinge and rural communities were divided into smaller groupings, or clusters, based on their proximity to each other. Homes located in areas with poorly drained soils or high water table were also clustered together.

Design information for cluster systems of 3 to 34 homes was obtained from the Fountain Run Case Study. This information was combined with unit costs obtained from the EPA alternative collection manual. Homes with existing onsite septic tanks in good working order were not costed for replacement. Cost estimates for the installation of SDGS in the fringe and rural areas are provided below.

Fringe Community

The fringe area was grouped into 20 clusters. Table D-2 presents a summary of the capital cost and the length of sewer required for each cluster. As an example, the calculation of the capital costs for the 34-home SDGS cluster is presented below.

Table D-2. Fringe Area Clusters

Number of Clusters	Number of Connections	Capital Cost per Connection	Feet of Sewer per Connection
1	7	$2,633	174
6	10	$2,271	147
3	12	$1,723	83
10	34	$2,372	148
Total	383	$827,631	63,440

Septic **Tank Capital Cost. This** cluster contains 34 tanks. The EPA manual estimates the average installed septic tank cost to be $800 (1991 dollars). This yields a capital cost of $27,200 in 1991 dollars or $30,235 in 1995 dollars for the septic tanks in this cluster.

Sewer Main **Capital Cost. The** 34-home cluster requires 5,040 feet of 4-inch main. The EPA alternative collection manual estimates the cost per foot to install 4-inch pipe to be $9 per foot (1991). This yields a capital cost of $45,360 in 1991 dollars or $50,421 in 1995 dollars for the collection main in this cluster.

Total Capital Cost for Collection. The capital cost for collection is the sum of the capital cost for the units in the system incremented to 1995 dollars. For the 34-home cluster system the capital cost is $80,818, or a cost of $2,372 per home. Two hundred twenty homes in the fringe community have existing tanks which will be utilized by these cluster systems; therefore, the cost to replace these tanks ($195,636) has been subtracted from the total collection cost. The capital cost for collection in the fringe area is $827,631, as shown in Table D-2.

Operation and Maintenance Costs. The operation and maintenance cost for the SDGS system is included in the description of treatment for cluster systems, described later in this appendix.

Rural Community

For estimating the cost of cluster systems, the failing systems in the rural community were grouped into 4 clusters. Table D-3 presents a summary of the capital cost and the length of sewer required for each cluster. The capital cost of the SDGS clusters in the rural area were calculated using the same process as the fringe area.

Table D-3. Rural Area Clusters

Number of Clusters	Number of Connections	Capital Cost per Connection[1]	Feet of Sewer per Connection
2	10	$2,271	147
1	12	$1,723	83
1	35	$2,372	148
Total	67	$149,122	9,116

Capital Cost. The capital cost for collection in the rural area is $149,122, as shown in Table D-3.

Operation and Maintenance. The operation and maintenance cost for the SDGS system is included in the treatment part of the cluster system.

TREATMENT SYSTEMS

Centralized Wastewater Treatment

Many treatment technology options are available to communities that wish to employ centralized wastewater treatment. Community-specific characteristics, such as land cost and availability, wastewater characteristics and flow rates, desired treated wastewater effluent concentration, and solids disposal costs affect whether a particular treatment train may be the most cost-effective and reliable system for a particular community. For the hypothetical fringe and rural communities, different treatment trains are costed based on their expected community characteristics. For the rural community, due to the very small wastewater flow and the relatively large amount of land available, the treatment train costed includes a facultative oxidation pond, which requires a large amount of land but is economical and requires relatively little maintenance, and a chlorination/dechlorination disinfection unit. For the fringe community, the treatment train consists of a grit chamber, comminutor, sequencing batch reactor (SBR), and chlorination/dechlorination disinfection unit. The SBR was selected for the fringe community because it is capable of handling small wastewater flows and requires only a small amount of land, which may not be readily available in a fringe area. If removal of additional nitrogen is required, the facultative oxidation pond in the rural community is replaced by a SBR that provides nitrification and denitrification, and the SBR in the fringe community is modified to provide such treatment. Waste solids from the SBR unit is costed for disposal of via land application.

Cost Data

The costs for treatment of wastewater at centralized wastewater treatment facilities were estimated using the computer cost model Water and Wastewater Treatment Technologies Appropriate for Reuse (WAWTTAR) (Gearheart et al, 1994). WAWTTAR was developed to estimate the feasibility and cost of water supply, wastewater collection, and wastewater treatment. The WAWTTAR cost model estimates costs in 1992 dollars, which are then indexed to 1995 dollars. Inputs to the WAWTTAR cost model include the community wastewater volume and characteristic data, treatment trains, and land costs, as well as target treatment performance standards.

The cost of land for construction of treatment facilities varies significantly from location to location. In some areas, the local government may already own the land necessary for construction of treatment facilities. In these instances, the land cost for treatment facilities will be minimal. However, many communities may need to purchase additional land to construct treatment facilities. The cost of the land will vary greatly from location to location. In the state of North Carolina, for example, land costs may range from $5,000 per acre in rural communities to $50,000 per acre in more developed areas (Hoover, 1996). Land costs for this report are based on an approximate average cost of $25,000 per acre.

The basic SBR and disinfection treatment system for the fringe community and the facultative oxidation pond and disinfection for the rural community are expected to reduce the biological oxygen demand (BOD) of the wastewater, as well as reduce suspended solids and fecal coliform bacteria.

These are parameters that would be included in most NPDES permits for municipal wastewater treatment facilities. The following treatment standards were input to the WAWTTAR cost model:

BOD	• 30 mg/L;
Suspended solids	• 50 mg/L; and
Fecal Coliform	• 200/100 ml.

The SBR modified to provide nitrification and denitrification, which was used for both the fringe and rural communities to remove nitrogen would meet the above standards and also reduce total nitrogen in the wastewater to 6 mg/L.

System Design and Cost

The cost estimates for centralized treatment of the wastewater from the rural community includes construction of a new treatment system dedicated to the community's wastewater. The cost estimates for centralized treatment of the wastewater from the fringe community includes expansion of the existing metropolitan center treatment plant to accomodate the additional flow. The centralized treatment costs discussed in this section do not include collection costs to transport the wastewater to the treatment facility, which were presented earlier in this appendix. Capital costs include the cost to purchase land on which to construct the facility, design, construction materials and equipment, and labor costs. Operating and maintenance costs include treatment chemicals such as chlorine and sulfur dioxide, energy to run equipment such as mixers, pumps, and aerators, and labor.

In some communities, existing wastewater treatment facilities may have sufficient capacity to treat additional wastewater from nearby community developments, such as the fringe community. Other communities may be capable of upgrading or expanding their existing wastewater treatment facilities; such modifications may range from minor operational changes to extensive upgrades and/or construction of additional facilities. The extent to which existing facilities must be modified to accommodate additional wastewater is highly dependent on site-specific factors, such as the existing capacity of the sewer and lift stations and treatment plant, and the effluent standards that must be met by the facility. Due to these highly site-specific factors, little or no capital investment would be necessary in some communities to enable an existing facility to treat additional wastewater, while in others upgrading the existing facility would be more expensive than construction of a completely new facility. Where existing facilities are used to treat additional wastewater, additional operating and maintenance expenses would be incurred from the use of additional oxygen and treatment chemicals, disposal of additional sludge, possible permit modifications, and other costs that are primarily and secondarily related to the volume of wastewater treated.

Fringe Community Costs (1995 $)

The capital cost to expand the existing metropolitan centralized wastewater treatment system consisting of a grit chamber, comminutor, SBR, and chlorination/dechlorination unit to accomodate the flow from the fringe community is estimated to be $464,000. Annual O&M costs are estimated to be $61,000.

Rural Community Costs (1995$)

The capital cost to install a centralized wastewater treatment system consisting of a facultative oxidation pond and a chlorination/dechlorination unit to service the rural community is estimated to be $439,000, while annual O&M costs are estimated to be $14,000.

Cluster Systems

A cluster system treats wastewater from a localized group of homes and is often used in conjunction with an alternative collection system. Cluster systems may include a central leach field for subsurface discharge, or may discharge to surface waters. The cluster systems evaluated for the rural and fringe communities consists of onsite septic tanks, and central sand filters and leach fields. The main components of a central leach field are dosing siphons/tanks pumps, adsorption trenches, and land. The main components of a sand falter are pumps, dosing tanks, and the falter.

cost Data

Cost estimates were developed for a central leach field to serve a cluster of homes. The Fountain Run case study (Abney, 1976), which was used to develop alternative collection costs, also provides design information on leach field treatment. The case study provides capital cost data for a community divided into clusters ranging from 3 to 34 homes. The study includes unit cost data (1976) for leach field treatment; including construction of the adsorption trenches. More recent cost data were used for sand filter treatment for cluster systems (Otis, 1996) and for land. As with centralized treatment, the cost for land is based on the approximate average cost of $25,000 per acre for North Carolina (Hoover, 1996).

Operating and maintenance costs include pumpout of the individual septic tanks and replacement of distribution pump every 10 years, and quarterly inspections of the cluster systems. Cost data were obtained from the COSMO cost model (Renkow and Hoover, 1996) developed at North Carolina State University and are described in detail in the onsite system section, described later in this appendix.

System Design and Cost

The homes in the fringe and rural communities were divided into smaller groupings , or clusters, based on their proximity to each other. Homes located in areas with poorly drained soils or higher water table were also clustered together.

Design information on leach fields for cluster systems of 3 to 34 homes was obtained from the Fountain Run case study, and was combined with the average cost per acre of land to comprise the capital cost for the leach field system. The capital cost for sand filter treatment is based on wastewater flow, and is estimated to be $15 per gallon (Otis, 1996). Operating and maintenance costs were obtained from the COSMO cost model. Cost estimates for the installation of treatment systems in the fringe and rural areas are provided below.

Fringe Area

To correspond with alternative collection costs, the fringe community was broken into 20 clusters. In the fringe community, cluster systems were costed for sand falter treatment followed by a leach field. Table D-4 presents a summary of the capital cost for cluster systems in the fringe community.

Table D-4. Fringe Area Clusters

Number of Clusters	Number of Connections	Capital Cost per Connection
1	· 7	$6,598
6	10	$6,914
3	12	$6,529
10	34	$6,639
Total	383	$2,953,421

Capital Cost. The cost for the leach field treatment follows the methodology outlined in the alternative collection section. The sand filter treatment cost was estimated as $15 per gallon of wastewater treated. Using the basis of 175 gallons of wastewater produced per home, a sand falter 'treatment system is estimated to cost $2,625 per home. The capital cost for treatment in the fringe area is $2,953,421, as shown in Table D-4.

Operation and Maintenance Cost. The operation and maintenance (O&M) cost for the combined collection and treatment cluster was obtained from the COSMO cost model. Maintenance of the onsite systems, including yearly inspections and pumpouts every 10 years cost $32 per year. Quarterly inspections of the central leach field cost $100 per year; additional inspection time for the sand falter is expected to cost an additional $25 per year. Pump replacements are expected to occur three times over the life of the system and cost a total of $1,800.

Rural Community

To correspond with alternative collection costs, the failing systems in the rural community were broken into 4 clusters. Table D-5 presents a summary of the capital cost for each cluster.

Table D-5. Rural Area Clusters

Number of Clusters	Number of Connections	Capital Cost per Connection
2	10	$6,914
1	12	$6,529
1	35	$6,639
Total	67	$448,992

Capital Cost. The cost for the leach field treatment follows the methodology outlined in the alternative collection section. The sand filter treatment cost was estimated as $15 per gallon of wastewater treated. Using the basis of 175 gallons of wastewater produced per home, a sand filter treatment system is estimated to cost $2,625 per home. Sand filter costs are added to the costs for the 4 cluster systems (serving 67 homes) located in areas with poor soil conditions. The capital cost for cluster treatment in the rural community is $448,992, as shown in Table D-5.

Operation and Maintenance. The operation and maintenance (O&M) cost for the combined collection and treatment cluster was obtained from the COSMO cost model. Maintenance of the onsite systems, including yearly inspections and pumpouts every 10 years cost $32 per year. Quarterly inspections of the central leach field cost $100 per year; additional inspection time for the sand filter is expected to cost an additional $25 per year. Pump replacements are expected to occur three times over the life of the system and cost a total of $1,800.

Onsite Treatment

Onsite systems treat wastewater from individual homes, thereby eliminating the need for a centralized collection and treatment system. A conventional onsite system consists of a septic tank, gravity distribution leach field, and the soil beneath the leach field (Hoover and Renkow, 1997). Solids from the wastewater deposit in the septic tank where anaerobic decomposition occurs. The effluent is dispersed throughout the leach field where it infiltrates the soil. Additional treatment, such as aerobic decomposition, occurs in the soil.

Because of site-specific conditions, some onsite systems require additional treatment units or use different methods of distributing the wastewater to the leach field. Two system modifications evaluated for the hypothetical community were low pressure pipe (LPP) distribution and sand filter treatment. Systems that utilize LPP distribution include a pump, pump tank, floats and controls, and a pressure distribution system, including small diameter (1.25-inch) PVC lateral pipes with small perforations.

Cost Data

Onsite treatment costs were estimated using the COSMO cost model (Renkow and Hoover, 1996). Equipment and labor costs (1995 dollars) reflecting the Wisconsin area were obtained and entered into

COSMO to develop cost estimates. However, it should be noted that onsite treatment costs vary by region and may in fact be more or less cost-effective depending on site-specific conditions and costs.

Onsite capital costs include upgrades (i.e., replacement systems) for failing systems in the rural and fringe communities, as well as new systems for the future development in the fringe community. Operating and maintenance costs include quarterly inspections of the onsite systems, including septic tanks, leach fields, and sand filters. O&M costs also include pumpouts of the septic tanks and replacement of the distribution pumps every 10 years. The establishment of one district to provide wastewater management to the fringe and rural communities assumes the district will take over maintenance of all existing and future onsite systems; therefore, the annual O&M cost estimates include costs for the existing onsite systems that are still functioning effectively.

System Design and Cost

Two onsite treatment systems were evaluated for the hypothetical community:

- Septic tank with low pressure pipe (LPP) distribution to a leach field
- Septic tank with sand filter treatment and LPP distribution to a leach field

LPP systems were chosen because they provide dosing and resting cycles in the leach field and distribute the wastewater more effectively throughout the system. LPP distribution is effective in areas with poor drainage, such as some of the homes in the hypothetical rural and fringe communities. Sand filters provide additional treatment to meet performance goals in systems located in ecologically sensitive areas and/or areas with high water tables, such as the homes located near the river in the rural community..

Rural Community

About half (67) of the 135 onsite systems currently in operation in the rural community are failing. Twenty of the 67 failing systems are located in an area near the river with a high water table. These systems need to achieve better quality discharge; therefore, the cost estimates include installing a new onsite systm equipped with a septic tank, a pressure-dosed single pass sand filter and a low pressure pipe distribution system to a leach field. Forty-seven of the 67 failing systems are located in areas with poor soils; the cost estimates include installing a new septic tank with a low pressure pipe distribution system to replace these systems. Capital costs for the rural area are estimated to be $510,000.

Annual O&M costs include maintenance of the 67 newly upgraded systems, as well as maintenance of the 68 current systems that still function effectively. These existing systems consist of a septic tank and gravity distribution system to a leach field. Annual O&M for the rural area is estimated to be $13,400.

Fringe Community

About half (110) of the 220 onsite systems currently in operation in the rural community are failing. Thirty-three of these failing systems are located in an area near the river with a high water table. These systems need to achieve better quality discharge; therefore, the cost estimates include installing a new onsite system equipped with a septic tank, a pressure-dosed single pass sand filter and a low pressure pipe distribution system to a leach field. Seventy-seven of these failing systems are located in areas with poor soils; the cost estimates include installing a new septic tank with a low pressure pipe distribution system to replace these systems. The cost estimates for onsite treatment in new fringe community homes also include installing new septic tanks with low pressure pipe distribution to a leach field for all future homes (223 systems). Capital costs for the fringe community is estimated to be $2,117,095; O&M costs are estimated to be $59,240.

Appendix E

Case Studies

(Excerpted from "Managing Wastewater: Prospects in Massachusetts for a Decentralized Approach")

Nova Scotia, Cananda

The noncontiguous district

A law passed in 1982 allows Nova Scotia towns and municipalities to create Wastewater Management Districts. The idea is to provide uniform "flush and forget" services to building owners, regardless of the mix of technologies and regardless of who owns the systems. All property owners in the district are obliged to participate in the funding, paying an annual charge that, covers capital recovery as well as operation and maintenance costs. Boundaries of the district need not coincide with the existing town boundaries, and would typically be smaller.

In fact, the district maybe "noncontiguous," consisting of individual properties or groups of properties that require special consideration for environmental or historical reasons. The administrative institution is either a sewer or public works committee of the municipal council. It is vested with all the necessary authorities and duties. It can own or lease land, make contracts, and fix and collect charges. It is held responsible for overall planning; upgrades; and design, construction, inspection, operation and maintenance of alll types of systems. Finally, it can enter private property to inspect repair, or replace malfunctioning systems.

In Port Maitland (population 360), a preliminary study estimated a per household cost of $6000 to $10,000 to install a conventional plant. The town opted instead for a mix of individual onsite systems and four cluster systems fed by gravity sewers to central septic tanks, siphon chambers, and contour subsoil trenches. Installation costs were approximately $2400 per unit. Maintenance, repair, and pumping are, provided by private contractors with the District. Annual fees per household were $65 in 1994. Recent studies have shown that despite seasonally high groundwater, the systems are functioning well.

Guysborough, with a similar population, adopted a plan that includes a small conventional treatment plant for part of the town, an aerated lagoon for another part, and individual onsite systems for a third part. All owners were assessed $2100 initially, and were charged annual fees of $125 in 1994.

Voter approval of those in the district is required; it must be presented to them as a complete plan that has considered sites, boundaries, servicing options, preliminary designs, and cost estimates. However, districts have often been voted down. Only three Nova Scotia towns had adopted such districts by the spring of 1994. Of sixteen others that considered it, decentralized management was actually recommended in fourteen cases. But six had.

chosen to centralize, and five were still in nebulous discussion. Five others were actively considering OWMD programs. Equity of either service or cost has been an issue in towns considering a mixed approach. Furthermore, central answering is often regarded by the public as more desirable and less interfering. Aside from questions of equity, voters have not always perceived that a problem existed, or that a Wastewater Management District was the entity to fix it.

Sources

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Cass County, Minnesota

Rural electric cooperatives manage service districts

Cass County is typical of the counties in the "Northern Lake Ecoregion" which have evolved from an economy based on agriculture and timber to an economy where the lakes and associated tourism have become very important. Because much of the development and growth around the lake regions took place in earlier years, there wasn't great attention paid to lot sizes, soil types, or to consideration of water quality. Cacc County is now faced with a growing number of nonconforming onsite septic systems around many of its rural Iakes Furthermore, the state Shorelands Management Act and Minnesota Pollution Control. Agency (MPCA) regulations, are setting tighter regulatory wastewater standards which Cass County is obliged to enforce. And many residents are in the unfortunate position of being unable to sell their homes due to the fact that they can not provide a "conforming" septic system on their property. Cass County has been pressed to look for answers.

In 1994, the county developed the concept of the "Environmental Subordinate Service District," whereby a township, as the local unit of government, can effectively provide, finance, and administrate governmental services for subsets of its residents. Establishment of such districts within a town is now authorized under Minnesota Statute 365A. So far, one district has been formed; five are in planning stages. The purpose of these districts is to provide a self-sufficient, effective, and consistent long-term management tool, chiefly for neighborhood alternative (STEP) collection and communal leach fields. This model is innovative, because it stays at the grass roots level where the affected property owners and the township remain involved. Cass County provides technical and support assistance when required, but is not directly involved on a daily basis. The partnering with the townships and the county has allowed. resource sharing, improved communication, and thus has opened up prospects for other cooperative ventures such as land-use planning, road improvements, and geographic information systems.

Once a Subordinate Service District is created by petition and vote from the residents needing the specific service, a County/Township agreement is signed. The County then determines the system's design, handles construction oversight, gives final approval for the collection system, commits to yearly inspections, and assures regulatory compliance. The leach fields are located away from lakes, wells, and groundwater supplies. Cass County will allow systems to lie on county-administered land in order to defray residents' costs, or to enable optimal siting.

The township is the legal entity that secures management services needed for the district to function. Other key players are the MPCA'S Brainerd Regional Office, providing regulatory and technical assistance, the Association of Cass County Lakes for lake and water quality monitoring and educational support, the Minnesota Association of Townships for their legal counsel, the Mutual Service Insurance Agency for insuring the townships and the district wastewater collection systems, the Tri-County Leech Lake Watershed (district) for their engineering funding, and the Woodland Bank of Remer for working with the township to obtain low interest financing-for residents.

However, another key and major player is the Rural Utilities Services (formerly the Rural Electrification Association). The piece of the puzzle missing for the districts to actually work was an operations, maintenance, and management program. Therefore, Cass County sought out the local utility,, Crow Wing Power and Light (Brainerd, MN), and asked them to consider helping. Crow Wing Power and Light now provides the following services as utility managers: (1) security monitoring; (2) monthly inspections (they also maintain the-grounds); (3) through a subcontractor, pumping of individual septic tanks, and any other repair or maintenance required; and (4) record keeping—logs are kept of inspections and repairs/maintenance. Bills are sent to the residents involved every six months, totalling about $200 per year per household.

A management maintenance contract is negotiated for the utility's services, thus reducing the need for additional staffing by the town itself. The township remains the legal entity guaranteeing any unpaid charges through its power to levy special district taxes. . .

Source

This (extracted) text has been supplied by Bridget I. Chard, Resource Consultant, Red River Ox Cart Trail, Rte 1; Box 1187, Pillager, MN 56734; tel. 218-825-0528.

Stinson Beach, California

Another classic, enforceable by shutting off town water

Stinson Beach is a small town in Marin County, located about 20 miles north of San Francisco. Part of the beach is a park that can draw 10,000 visito~ on a weekend. The town generally answers to Marin County government. At present there are about 700 onsite systems in Stinson Beach. It is another early participant in the onsite management concept.

In 1961 a county survey concluded that surface and groundwaters were being polluted by many of the town's often antiquated onsite systems. In response, the county created the Stinson Beach County Water District, whose task would be solve the problem. The water district is governed by a five-member, elected Board of Directors who make policy and perform water quality planning. Between 1961 and 1973, nine separate studies and proposals for central treatment were rejected by voters. In 1973 the San Francisco. Regional Water Quality Control Board (SFRWQCB) intervened, putting Stinson Beach on notice. AH onsite systems would be eliminated by 1977, and a building moratorium would go into effect forthwith. Even so, a tenth central sewer proposal was rejected. Voters were not only alarmed by costs, but were unconvinced that alternatives had been sufficiently considered. An eleventh study, specifically undertaken to examine alternatives, concluded that onsite remediation was both the most cost effective and environmentally benign.

Concurrence was sought from both the regional board and the state legislature, which enacted special legislation (consistent with California Water Code provisions) in 1978 empowering the Stinson Beach County Water District to establish the Stinson Beach Onsite Wastewater Management program. The program would answer directly to the SFRWQCB, rather than to Marin County. The program would govern the permitting, construction; inspection, repair, and maintenance of old and, later, new systems. Rules and relations were approved by the regional board on a trial basis, and were later made permanent. The program went into effect with the passage of a series of town ordinances. Rules and regulations (and ordinances) have evolved as problems were encountered, there being few precedents to go on.

Ownership of the systems, and ultimately the responsibllity for repairing or upgrading them, rest with the building owner. But program staff perform inspections out of which' come permits to operate, or instead a citation that lists violations and provides a timetable for remediation. (Initially a house-to-house survey was used to identify the most critical' failures or substandard systerns from which came interim permits to operate.) As in the case of Georgetown, the permit to operate is conditional on authorizing the district to enter property for purposes of inspection and, if need be, repair. Conventional systems are inspected every two years, alternative systems (now stipulated for some areas) every quarter. The permit may carry conditions, or varying periods of validity. The regulations provide penalties for noncompliance of up to a $500 fine or 60 days imprisonment, each day considered another count. The district also has the power to effect its own repairs and put a lien on the property until repaid. And it has access to low-interest state loan funds for low-income households. .However, it has rarely had to take, strong measures because the district is also empowered to cut off the water supply of a noncomplier, something it has had to do occasionally. During the initial period, about half the existing systems were found to require repair or replacement. ‘

Five staffers approve plans, and inspect and handle compliance. The budget is met partly out of tax revenues and partly by a $53 per household semiannual fee. Special inspections or inspections for compliance are also charged for.

Problems encountered at Stinson Beach mostly had to do with delays as bugs were worked out and sudden demands were put on staff as well as private engineers and installers. One completely unanticipated problem: Access ports, required of system owners, were leading to’ a serious mosquito problem; redesign of the ports resulted. Then, in ‘1992, the RWQCB imposed a moratorium on new systems pending reevaluation of the program, revised (and tighter) technical, approval and tracking procedures, and the development of a more adequate staffing and fee structure. New ordinances were passed in 1994, and the program is back on track. Not without some growth pains, this 17-year old program is regarded as both successful and adaptable to other locales.

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Keuka Lake, New York

A home-rule intermunicipal agreement, eight towns strong

Lake Keuka lies in upper New York State's "Finger Lakes Region." The Keuka watershed supplies water for over 20,000 people; over 10,000 live on the lake's shores, which border 8 municipalities and two counties. Overall, water quality in the lake is good, but occasionally elevated levels of sediment, nutrients, and pathogens have been recoded. Pollution, and its potential impact on health recreation, property values and the associated tourism industry, led local townspeople to identify watershed management as their leading concern.

This concern was uncovered by a civic group, the Keuka Lake Association; more than 30 years old, it ultimately comprised 1700 members and was able, via its nonprofit Foundation, to acquire $180,000 in grants and other revenues for study and planning purposes. It went on, in 1991, to establish the Keuka Lake Watershed Project, whose more specific purpose was to promote uniform, coordinated, cooperative watershed management for the region. There were three prongs to its effort: (1) establish details of the current situation; (2) educate the public to the need for action; and (3) foster inter-institutional cooperation,

With regard to the latter, it encouraged the formation of individual Town Watershed Advisory Committees that would provide local participatory forums to address water issues, and at the same time report to the Project's director. An early suggestion of the individual committees was to form a single, oversight committee, consisting of elected officials from the eight municipalities around the lake. This committee came to be called the Keuka Watershed Improvement Cooperative (KWIC). Initially it had no official status.

The stated purpose of the Cooperative was to develop a model watershed law, and then identify who should administer it. In developing the law it specifically excluded facilities of such a size that they were already regulated by the state. When it came to administration, they examined and rejected forming a regulatory commission through the state's enabling procedures, and they examined and rejected county-based ("county-small") watershed districts. Instead, they opted for drawing up an intermunicipal agreement under the state's Home Rule provisions which allow the municipalities to do anything together (by agreement) that they could have done separately. The agreement, itself, was only 8 pages long. It legally formalized the cooperative, providing for a board of directors consisting of the Chief Executive Officer of each municipality y, and for a professional watershed management staff. Voters were presented with a package consisting of the agreement, the proposed watershed protection law, arid recommended policy and procedures, including those for dispute resolution. After dozens of public meetings the package won by a landslide in every municipality.

Regulations govern permitting, design standards, inspection and enforcement. A program for all sites in “Zone ‘One,” the land within 200 feet of lake, calls for their inspection at least once every five years. Failures are cited and required upgrades stipulated. Aerobic and other alternative systems must be inspected annually, at which time the owner must show evidence of an extant maintenance contract. Specifications for the design, construction, and siting of replacement systems are also tighter than the state’s, and ‘approval may require the use of advanced or “Best Available Technology.” Enforcement provisions define violations, and specify timetables for compliance and fines. The individual, municipalities issue notices of violations and citations to appear in town or village court.

The Cooperative coordinates its activities with state and county health agencies, maintains a database and GIS system to track environmental variables and the performance of new technologies, continues with ongoing studies, and retains a Technical Review Committee to help with policy and regulatory modifications. Staff include a full time watershed manager, employed by KWIC, and part time inspectors, employed by the towns.

KWIC is financed by septic system permit fees, grants as available, and funds from each member municipality’s annual budget. The annual KWIC budget forecasts permit fees, considers grant funds immediately available, and distributes the balance of funds needed evenly among the towns and villages.

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Gloucester, Massachusetts

Exploring new approaches for Massachusetts' cities

Gloucester is a fishing port (population, 30,000) on the rocky coast of Cape Ann, about 40 miles north of Boston. White 40% of the city is sewered, the particularly troublesome area of North Gloucester is not. Failed septic systems have resulted in the closing of shellfish beds, and since 1979 the city has been under a consent decree to comply by 1999 with state clean water standards. Numerous environmental problems were initially taken to imply that North Gloucester should be required to hook into the city sewer. These included shallow soil depth, a high groundwater table, wetland areas, and numerous private wells.

The hookup was partially underway when the EPA Construction Grants program was terminated in 1985, leaving Gloucester still with a problem, and still under a consent decree. Aware that centralized hookups would now become extremely expensive to homeowners, and also aware that the central ' sewer provided only primary treatment (albeit waivered for the time being), the city began an examination of the many ramifications of decentralized management, and many. discussions with the state's Department of Environmental Protection.

In ongoing negotiations for its consent decree, Gloucester is pioneering a new approach to wastewater management in Massachusetts. It is in the process of developing a citywide wastewater plan that avoids construction of additional conventional sewer lines by proposing STEP sewers and/or ensuring that all onsite systems are properly built and maintained. Small community systems and package plants would be administered by the city's Department of Public Works, although their ownership is still under discussion.

Individual systems would still be administered by the Board of Health, albeit in a framework tougher than the state's recently revised (Title 5) regulations. As it presently stands, key provisions relating to individual systems include the following: An initial inspection and pumping will, be conducted by either Board of Health personnel or privately-licensed inspectors at the homeowner's option. Inspection will result in either an Operating Permit or an Order to Comply that stipulates upgrade or replacement requirements and a time frame for compliance. Regular inspections will follow, ranging from annual (for food industries) to every seven years (for residences). A BOH computer system now in development will record data from these inspections as well as from septage haulers. There are emergency repair provisions and financial relief (loan) provisions for qualifying homeowners to be funded through a

Betterment Bill bond issue. The system is to be financed by license fees from professionals and by inspection fees from homeowners. Contractors and haulers will be licensed annually by the city, which will also conduct training programs. Enforcement will rely on the ultimate power of the BOH to make repairs itself and then invoice, with collection, falling to the city and COurts. -

In areas unsuited for conventional systems, alternative technologies permitted by the DEP will be stipulated. For those, technical advice can be obtained from the DPW as well as the BOH. Such systems muse be accompanied by three-year maintenance contracts with either the DPW or a licensed manufacturer/installer. In North Gloucester a National Onsite Demonstration Project is underway to test innovative 'systems yet to receive general state approval. Not all details of Gloucester's plans are settled, and final approval has yet to be obtained from the DEP, which, however, is being consulted as the plan is developed.

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Appendix F

The Role of Rural Electric Cooperatives in Upgrading Facilities

THE ROLE OF RURAL ELECTRIC COOPERATIVES IN UPGRADING FACILITIES

BACKGROUND

Rural electric cooperatives are private entities that build and manage extensive rural utility systems. These cooperatives have the capability to address a full range of technical, financial, administrative, and regulatory issues related to the supply and management of electrical power. A report titled, "COMMUNITY INVOLVEMENT - Opportunities in Water-Wastewater Services, The Final Report of the NRECA/CFC Joint Member Task Force on Rural Water and Wastewater Infrastructure, February 1995" (CI Report), produced jointly by the National Rural Electric Cooperative Association and the National Rural Utilities Cooperative Finance Corporation, sets forth a "blueprint for rural electric cooperatives which decide to enter the water-wastewater business voluntarily." In the Fiscal Year 1997 House Appropriations Committee report, the Committee acknowledged the significant interest of the cooperatives "to expand their current role of delivering electricity to the delivery to rural communities of clean water and safe drinking water improvement technologies as well." The Committee "is uncertain whether expansion into this new field is an appropriate means of upgrading rural drinking and wastewater facilities to meet federal requirements." EPA was asked to review this matter and report on its findings prior to the Committee's fiscal year 1998 budget hearings for EPA. This response examines whether cooperatives are an appropriate vehicle to manage, operate, maintain and upgrade drinking water and wastewater systems. It is included as an appendix to an overall response to Congress on decentralized wastewater treatment systems.

There are approximately 900 rural electric cooperatives in the United States. An estimated 80 to 90 of these cooperatives are involved in some aspect of drinking water or wastewater management with the overwhelming majority dealing with drinking water management. Only a few of the cooperatives own wastewater treatment facilities or are currently involved in wastewater management.

KEY ISSUES

To determine whether cooperatives are appropriate management entities for managing drinking water and wastewater systems, there are several key issues to consider:

1. Authority for ownership/management,
2. Managerial and technical ability,
3. Ability to obtain capital, and
4. Ability to ensure continued management and operation and maintenance (O&M).

These issues are examined below for the purpose of determining whether cooperatives are appropriate for upgrading drinking water and wastewater facilities to meet federal requirements.

1. Authority for Ownership/Management. The CI Report notes that most states - all but 13 - have laws that authorize cooperatives to own and operate drinking water and wastewater facilities. The CI Report notes "...some cooperatives have used innovative methods to gain entry to the drinking water and wastewater business. Cooperatives. . . may be eligible through other methods of organization."

In addition to state and local authority, in the wastewater area, cooperatives must have each individual owners' agreement to upgrade and/or operate and maintain their onsite wastewater systems. This generally happens when a large percentage of homeowners have failing onsite systems and have a need for upgraded treatment which they cannot meet themselves, and for which local government is incapable or unwilling to meet. The owners retain the services of a cooperative which would seek the capital needed for the system upgrade. The cooperative would be charged with the responsibility for operation and maintenance of the system and charge a monthly utility rate for this service and the cost of needed upgrades.

In cases where centralized wastewater collection and treatment systems or water distribution systems already exist, but fail to meet the federal statutory or regulatory requirements, the same situation occurs. If the facilities are inadequate, the system owner must invest in improvements. An organization, such as a cooperative or other private entity, may take ownership of the system and provide operation and maintenance. Issues associated with privatization of wastewater are discussed in a companion document entitled, "Response to Congress on Privatization of Wastewater Facilities".

One area related to wastewater where cooperatives are having success is where state or local health officials have ruled that conventional onsite wastewater systems will not work due to soil conditions. In these cases, developers are usually not familiar with alternative systems and welcome cooperatives to take ownership and/or manage the new upgraded systems that they are required to install. There are two driving forces that are bringing this about: 1) the need for some form of wastewater treatment other than conventional septic systems, and 2) the revenue generated by each new homeowner (customer) for electric power (estimated at about $1,000 / yr / household).

A second area of success has been assistance and contract management to drinking water authorities, both public and private. The CI Report indicates that types of services currently provided include organizing, feasibility, bylaws, mapping, accounting and billing.

2. Managerial and Technical Ability. Cooperatives do not generally have the technical ability "in house" to conduct drinking water and wastewater feasibility studies and facility designs (with the exception of those which currently own or operate drinking water and/or wastewater facilities). However, they are well equipped with managerial capabilities and can contract for these technical services. In addition, cooperative associations have contracted with several drinking water and wastewater research-oriented professionals who provide technical assistance, including demonstrations of technology, thus giving them access to technically competent people. At least one state cooperative association is already performing demonstrations of alternative technologies (in Pennsylvania, five onsite system projects will be demonstrated).

Rural electric cooperatives have historically dealt with issues relating to the use of electricity to enhance the lives of inhabitants of rural areas in the context of economic development. Conventional onsite systems (septic tank and leach field) typically do not involve the use of electricity, while centralized systems and alternative types of onsite systems generally rely upon electricity for pumping, power, lighting and other activities. Therefore, there could be a possible concern that rural electric cooperatives might be more comfortable with constructing or managing facilities which rely on electric power versus those that do not. This concern would need to be addressed if rural electric cooperatives are to play a more prominent role in the construction and/or management of decentralized treatment systems. It should be noted that the Federal Agriculture Improvement and Reform Act of 1996 (the Farm Bill) prohibits cooperatives from requiring those receiving drinking water and wastewater services to receive electric services.

3. Ability to Obtain Capital. In the CI Report (chapter 9), there is considerable discussion of the various possible funding scenarios. Federal funding, including loans, grants, and guarantee programs, for drinking water and wastewater programs is provided by the following federal departments and agencies:

- USDA’s Rural Utilities Service (RUS)
- USDA’s Rural Business and Cooperative Development Service (RBCDS)
- USDA’s Rural Housing and Community Development Service (RHCDS)
- U.S. Department of Commerce’s Economic Development Administration (EDA)
- U.S. Department of Housing and Urban Development (HUD)
- U.S. EPA

There are many opportunities for funding other than federal programs, including loans from local financial institutions. In addition, two other sources of funding are the National Rural Utilities Cooperative Finance Corporation (CFC), and National Bank for Cooperatives (CoBank). The cooperatives’ managerial skills and equity provide support that other private or governmental organizations may not provide in rural areas. However, issues related to ownership and management of the facilities may limit where funds can be obtained. The CI Report provides six recommendations to Congress to strengthen the ability of cooperatives to obtain funding. These recommendations include: authorization for a re-lending program for system upgrades; funding for the Water-Wastewater Disposal Loan Guarantee program; removal of the “no-credit-elsewhere” condition in the loan program; financing for feasibility studies; eligibility for cooperatives to receive funds under all federal programs; and support for rural electric infrastructure activities.

4. Ability to Ensure Continued Management and O&M. Chapter 8 of the CI Report provides a strong basis for the ways that cooperatives can assist in management and O&M. Cooperatives are more likely to provide better management and O&M than small public (town) or private entities (e.g. homeowners’ associations) which cannot afford to staff up appropriately and typically run into political and financial conflicts. The ability to provide management, including O&M, could be the strongest and most valuable asset the cooperatives offer. The real problem in the wastewater area involves convincing the homeowners there is a need for management services, including O&M, of the onsite wastewater system starting from its initial installation.

CONCLUSIONS

In summary, drinking water and wastewater treatment facilities can be upgraded and managed by rural electric cooperatives, although 13 states would require enabling legislation for them to own and/or operate these facilities. Upgrades of drinking water and wastewater facilities by cooperatives could be a good solution in rural areas because cooperatives are non-political, known entities to the homeowners, that bring experienced management and staff to solve the O&M challenge, as well as options for obtaining capital. Also, the ability to provide management services, including O&M, can be the cooperatives’ most valuable asset.

From the drinking water perspective, cooperatives offer great promise as management entities for small water systems which lack institutional strength. However, for many reasons, some stated above, it is unlikely that more cooperatives will make significant movements into the drinking water and wastewater business quickly. These reasons involve interest on the part of individual owners to pay for onsite system management, the technical ability of the cooperative to manage drinking water and wastewater facilities, limited experience with low energy onsite technologies, and the ability to obtain capital. Once these issues are resolved, the communities and cooperatives may be able to work together to efficiently provide the needed improvements and services.